Prefabricated Lightweight Timber Ground Floor Systems R&D Project

Dr Alastair Woodard

Forest & Wood Products Australia

Project funded by FWPA

BRANZ

Bowens THE BUILDERS CHOICE

TPC Solutions (Aust) Pty Ltd

Timber ground floor construction is far from a new concept;

what is new, original and innovative is the

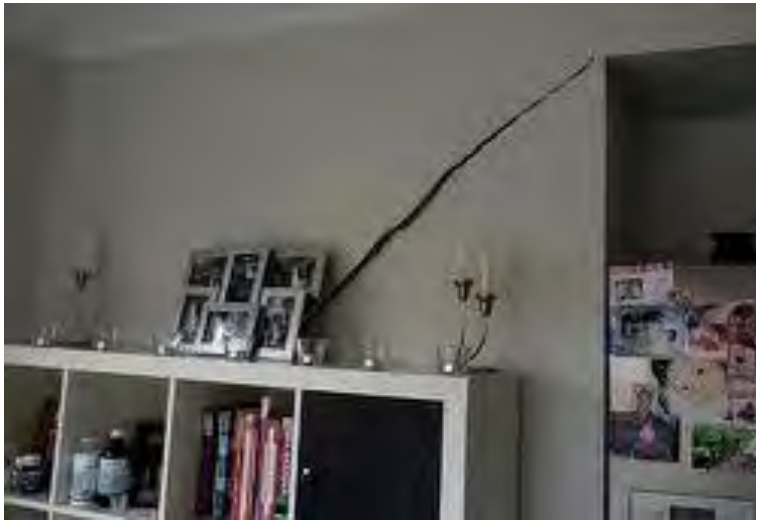
‘delivery method’ and the ‘market offering’

Prefabricated timber ground floor systems

delivered by Australia’s Frame & Truss manufacturing sector

Benefits: Flood Prone Areas - High & Dry

Benefits: Reactive Clays - Adjustable



Benefits: Sloping Sites – Lighter on the Land


KINGFISHER

Pre-investigation of builder's views on raised timber sub-floor construction

Findings

Comments Made & Issues Raised	Action Required
• **Sloping sites** – many builders would now just use a slab – 'industry norm' (unless cut & fill requirements too great to be economic)	• Need to investigate at what slope TSFs become a more cost effective option

Findings

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• **Sloping sites** – many builders would now just use a slab – 'industry norm' (unless cut & fill requirements too great to be economic)	• Need to investigate at what slope TSFs become a more cost effective option
• **Cost is the main driving factor** – most builders advised that they would shift if it could be demonstrated to be more cost effective	• Need to clearly understand and document costs

For the volume builders 'COST' is a major factor

- Not necessarily though for everyone

Findings

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• **Cost is the main driving factor** – most builders advised that they would shift if it could be demonstrated to be more cost effective	• Need to clearly understand and document costs
• **Slab easy and quick** – one contractor and can have a slab on the ground within 3 days, subfloor more difficult – multiple contractors and takes longer	• Need to have a 'design, supply and install' capacity – one contractor service

Timber Industry needs to match what the concrete sector offers

– supply & install

Findings

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• **Slab easy and quick** – one contractor and can have a slab on the ground within 3 days, subfloor more difficult – multiple contractors and takes longer	• Need to have a 'design, supply and install' capacity – one contractor service
• **Thermal Performance** - all were concerned about sub floors achieving the appropriate energy rating	• Need to identify cost effective insulation solutions for sub-floors
• **Low-lying areas** – Council requirement is to build at least 600mm above flood level - many builders just use a deeper more massive slab	• Need to investigate at what slab thickness that TSFs become a more cost effective option
• **Promotion of timber sub-floors** – general feeling was that the timber industry was simply not supporting its product whilst the concrete industry was	• Investigate what promotion industry should be doing to protect remaining market share (for new homes and alterations & additions)
• **New 'Waffle Pod' slabs –** are providing an even easier way to do slab on ground (slabs sit straight on ground no excavation for beams)	• Timber industry need also to investigate new, innovative, construction options

Currently some real issues for waffle pods – attitudes to 'cost' are changing

Findings

Builders in Australia currently prefer slab-on-ground to suspended timber floor systems; slabs today represent over 95% of the new residential market in some states

Builders have concerns with traditional 'built-on-site joist & bearer timber systems' particularly because of

- the multiple trades and contracts required and
- the longer construction periods compared to the slab-on-ground alternative.

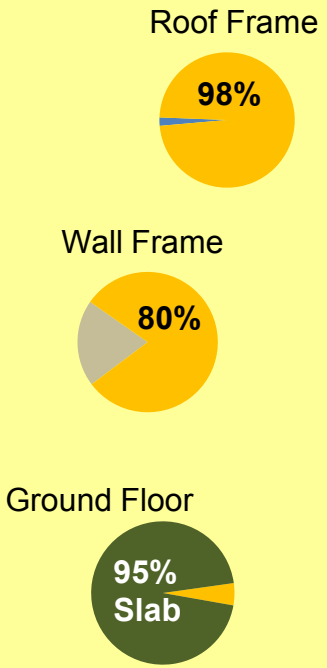
Builders today are used to, and want, –
'one contract, to deliver a working platform, on a site, on a specific date, for a specific cost'.

This is the challenge for a successful take-up of **easy-to-install, cost effective lightweight timber ground floor systems.**

Findings – Key Issues

Key issues to address include

- **offering a total system** that includes the **prefabricated timber floor**, the **supporting system** (with a number of options depending on site conditions) and a simple, effective and quick installation process;
- developing an **approach that has broad supply channel potential** – an approach that does not require specialists to deliver;
- securing engagement and **participation by the truss and frame sector – design / fabrication / install** – this provides a whole new value-added product line to manufacturers and a next step towards further prefabrication offerings (fully finished wall systems, fabricated roof modules etc.).



Prefabricated Lightweight Timber Ground Floor Systems

Project Activities & Timelines

Part A	Review	
		Critical review of what has been tried in regards prefab floor systems in the past and report on what is needed and how industry should/could respond
Part B	Design	
		Designing optimised floor system solutions
		Designing pre-fabricated floor support methods
		Design Analysis
		Designing on-site installation techniques and procedures
	Lab Testing	
		Project administration - FWPA contract & milestones
		Elemental and Full size testing of floor panel options for performance
		Elemental and Full size testing of between-panel jointing requirements
		Elemental and Full size testing of pre-fabricated floor support and tie-down
		Testing of in-shop floor insulation installation options
	Pilot	Full size testing of on-site installation techniques and procedures
		Construction of a full-sized home floor
		Preparation of copy for FWPA Technical Manual
		Launch
		Final Report and AFFR

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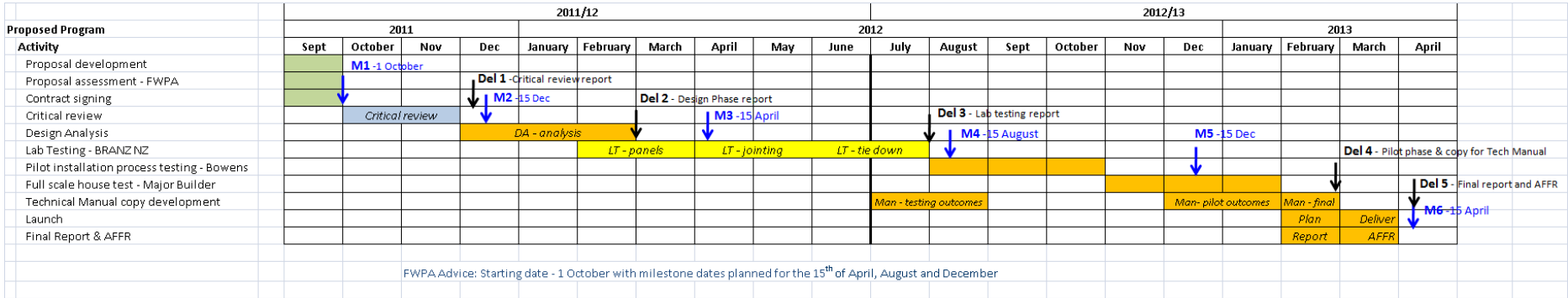


Stage 2: Design Optimisation

I. Optimised panel floor systems
(including floor insulation)

II. Floor support systems

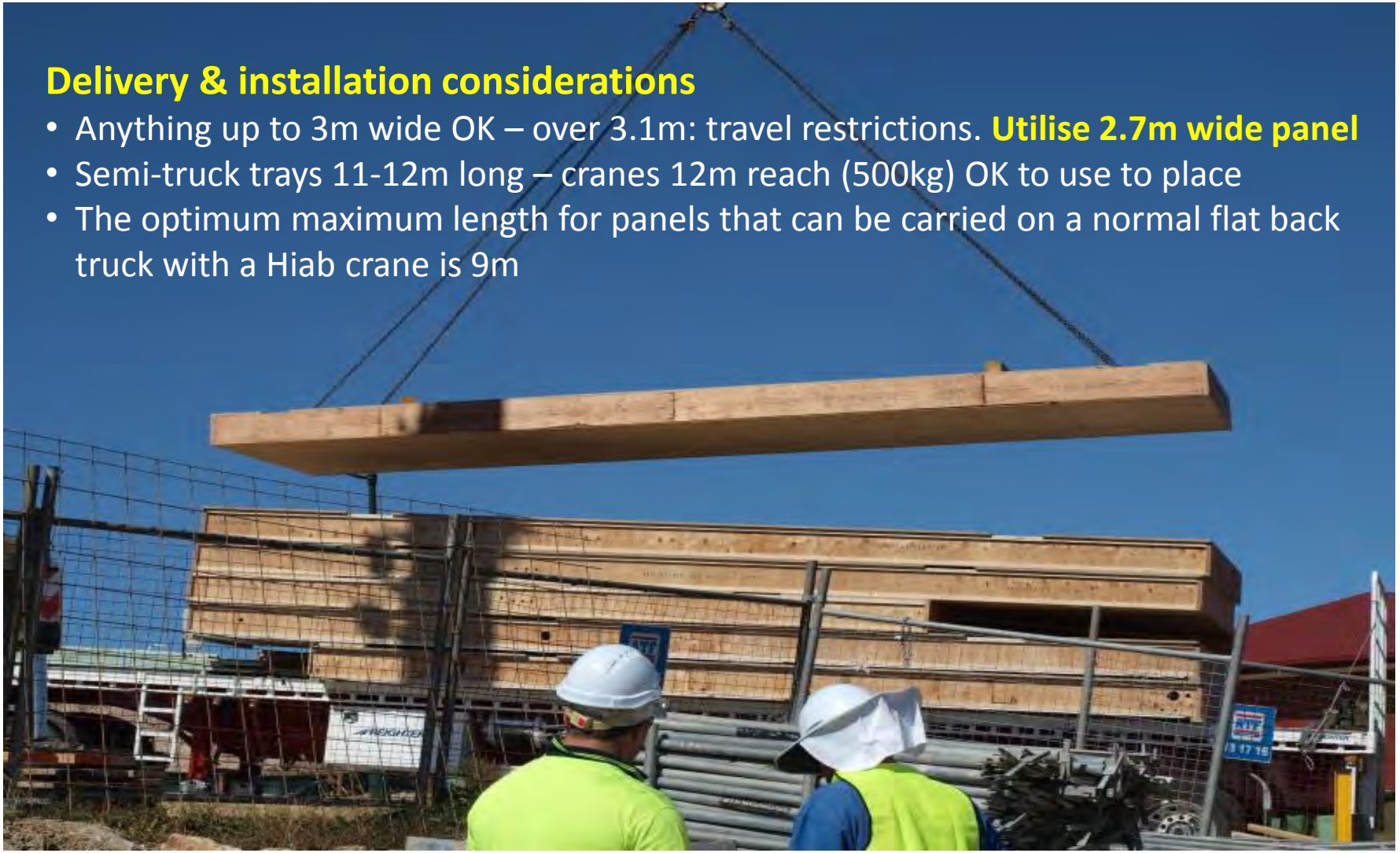
III. Onsite installation approaches

Optimised Floor Systems

Prefabricated Panelised Flooring Configuration Options
- optimised around

- delivery & installation considerations
- structural performance and materials cost,
- utilising the current range of commonly available structural flooring products, both
    - solid sawn and
    - engineered (plywood, particleboard, LVL, I-beams and floor trusses);

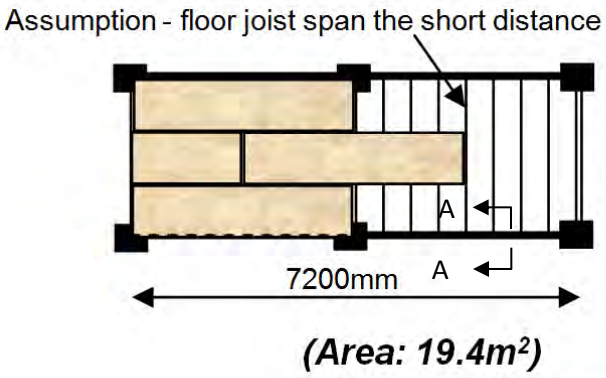
Optimised Floor Systems



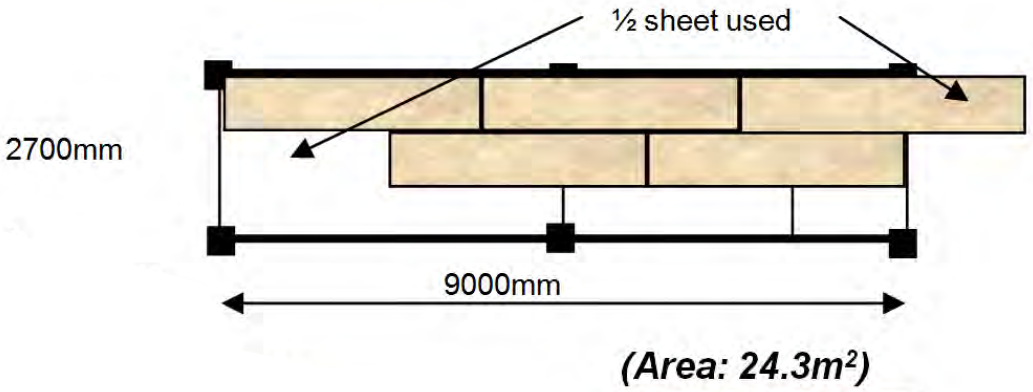
Delivery & installation considerations

- Anything up to 3m wide OK – over 3.1m: travel restrictions. **Utilise 2.7m wide panel**
- Semi-truck trays 11-12m long – cranes 12m reach (500kg) OK to use to place
- The optimum maximum length for panels that can be carried on a normal flat back truck with a Hiab crane is 9m

Optimised Floor Systems: S-Type

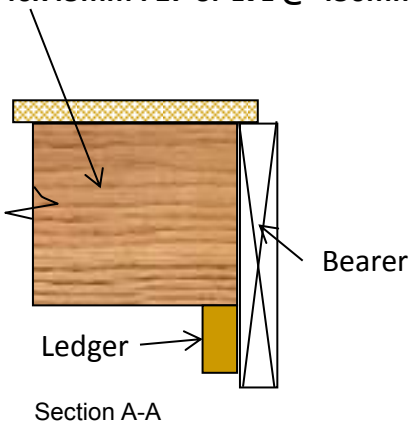


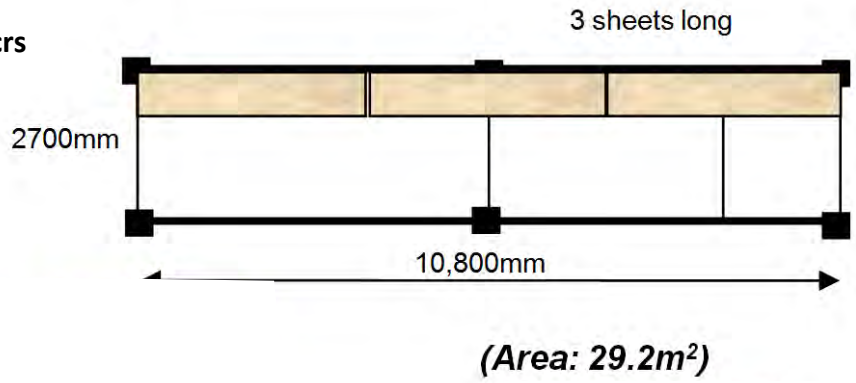
S1: Bearers
190x35mm F17 or LVL



S2: Bearers
240x45mm LVL

Floor Joists:
140x45mm F17 or LVL @ 450mm crs

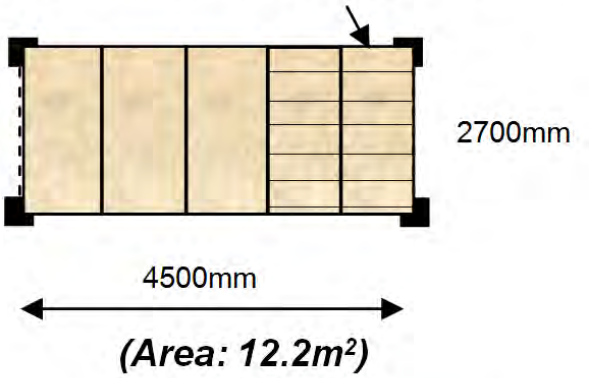


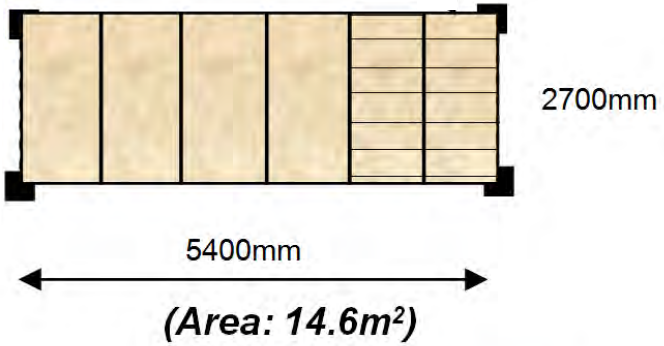


S3: Bearers
290x45mm LVL

Optimised Floor Systems: I and T-type

Assumption - floor joist span the long distance

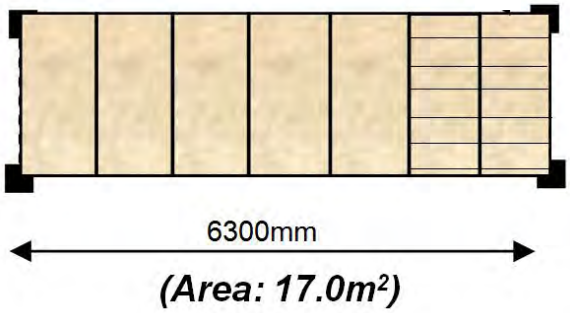




E1: Joists (@450mmcrs)
240 deep I-beams

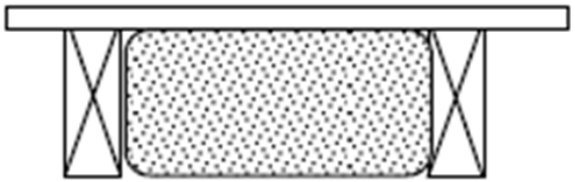
E2: Joists(@450mmcrs):
300 deep I-beams

E3: Joists (@450mmcrs):
360 deep I-beams

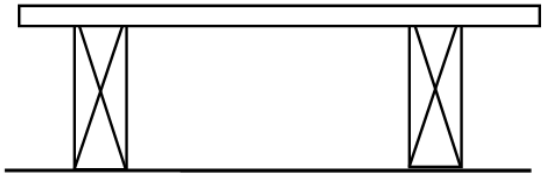


Optimised Floor Systems - Insulation

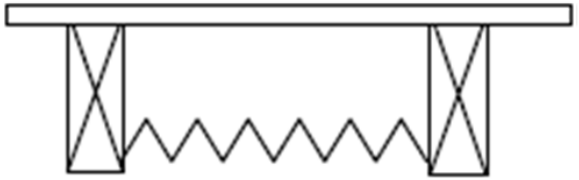
Insulation Options



Bulk:
Glasswool, Rockwool, Polyester

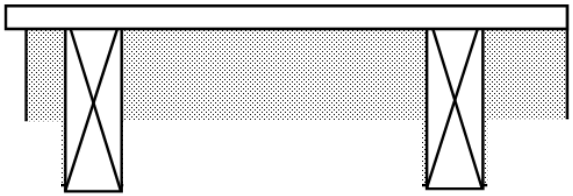


Cellular Foil Laminate

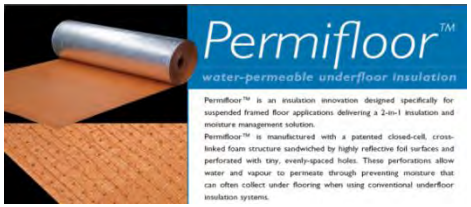


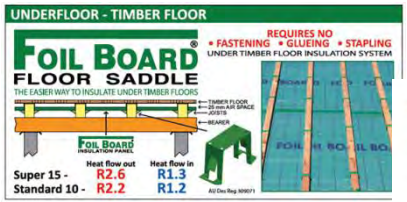
Concertina Foil

Expanded Polystyrene



Foam Spray





cosyfloor

Bradford optimo sub-floor

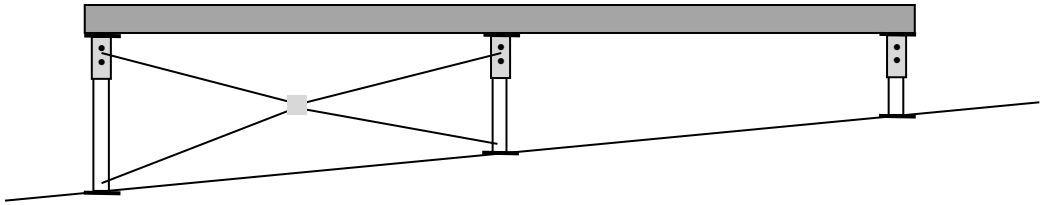
Stage 2: Design Optimisation

I. Optimised floor systems (including floor insulation)

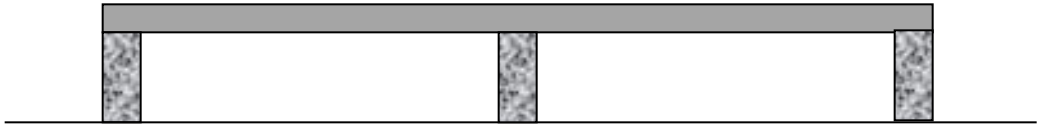
II. Floor support systems

III. Onsite installation approaches

Floor Support Systems

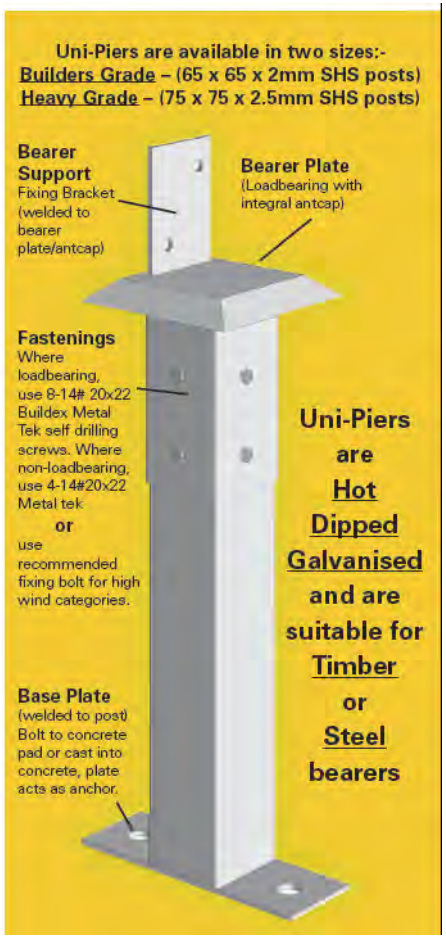


sloping sites, a braced adjustable steel pier approach is very effective allowing levels to be easily achieved *(a range of proprietary products exist with different approaches to adjustment and levelling).*



flat sites the adjustable steel pier can be used or a set-height precast pier product may prove more cost effective (typically minimum of 400mm high to meet building regulations).

Floor Support Systems – Floor to Ground

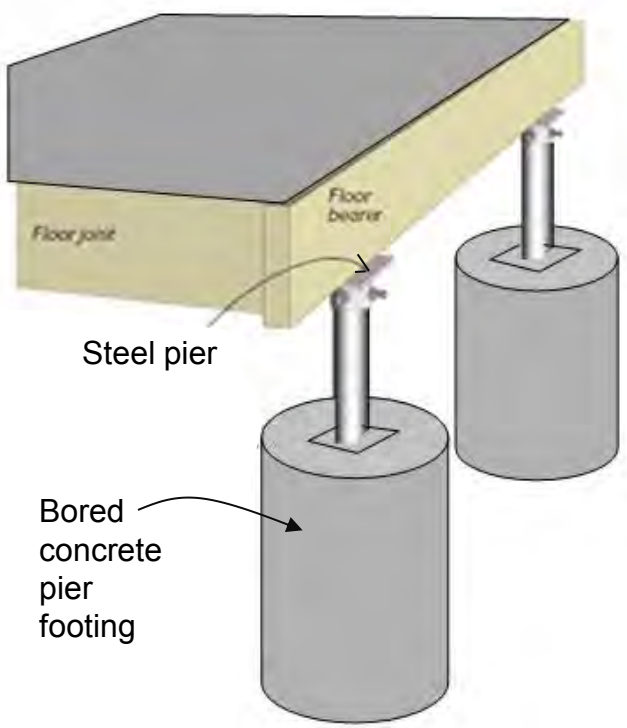


Uni-Pier

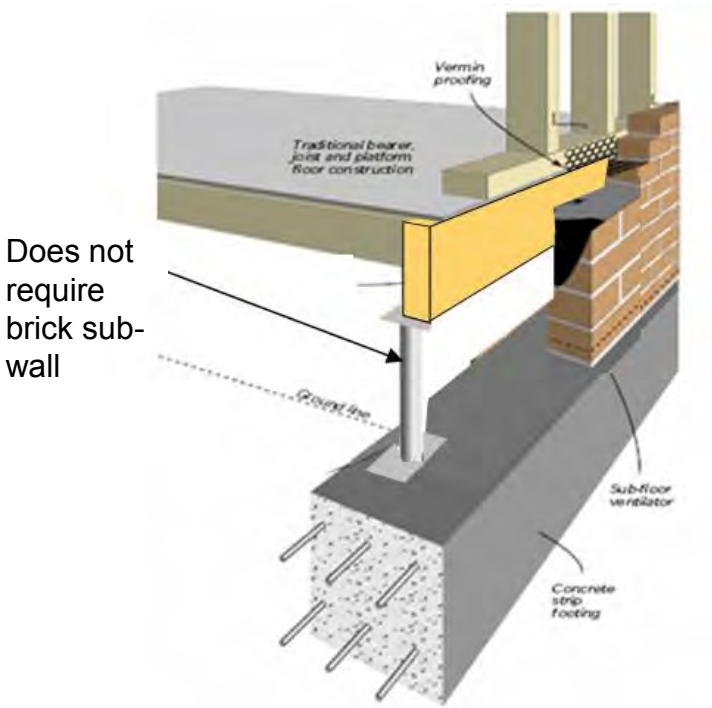
Advanta-Pier

Adjustable Steel Piers

Floor Support Systems - Footings



Bored Concrete Pier
(Lightweight external wall)



Conventional Strip Footing
(Heavyweight veneer external wall)

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Stage 3: Testing

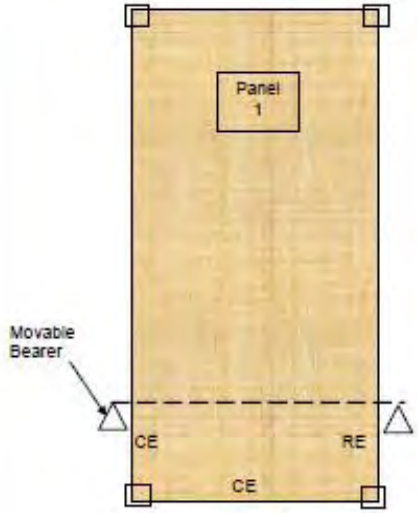
1. Elemental testing
2. Full panel testing
3. Installation Testing

Proposed Test Configurations and Aims:

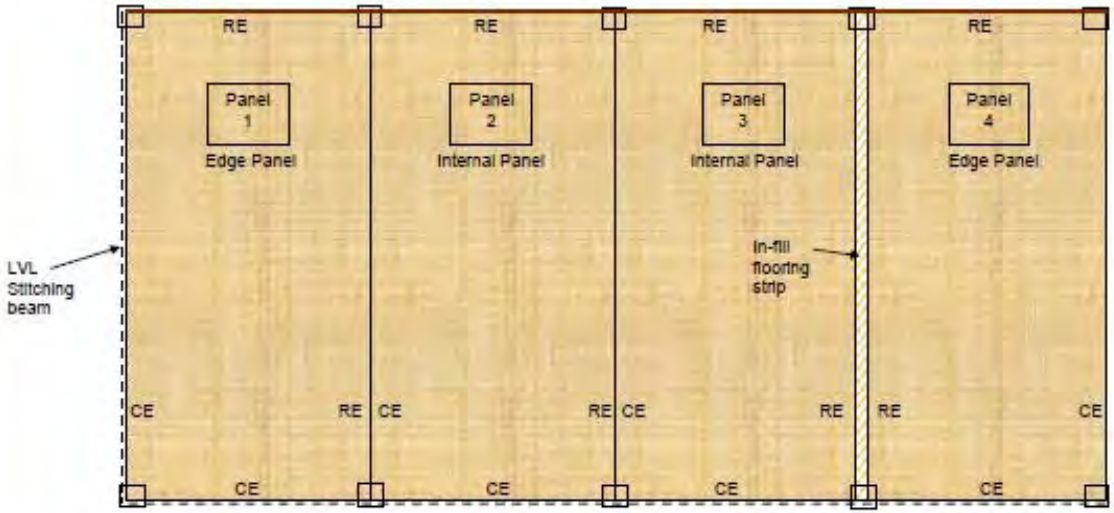
Test 1: Panel Bounce
Utilise one single panel and a movable bearer to test perceived/actual panel bounce

Test 2: Panel Assembly – long edge connection
Test cantilevered flooring and in-fill floor connection options
Investigate stitching beam installation
Investigate floor to pier tie-down requirements
Test panel bounce

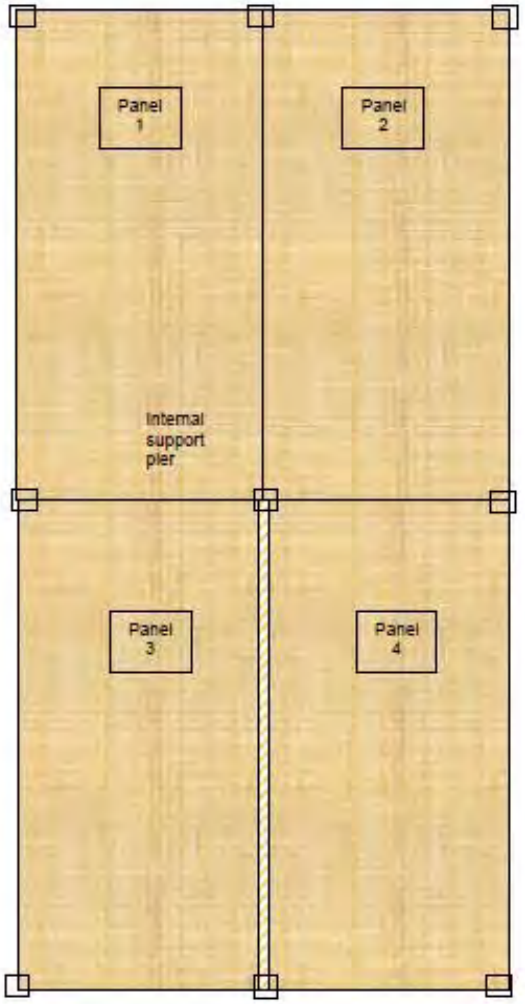
Test 3: Internal support performance
Test internal support pier tie-down requirements
Test panel bounce



Test 1



Test 2

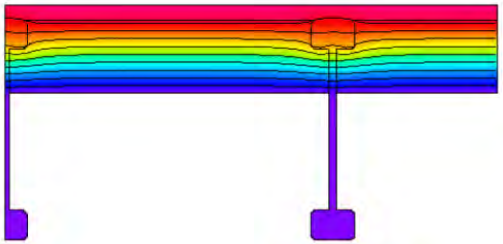


Test 3

CE: cantilever edge flooring RE: rebate edge flooring
See Test 2 Panel Connections Drawing – explains flooring edge details

Title: Test Panel Thoughts
Drawn: AW
Date: June 2012

BRANZ Full Panel Testing (NZ)



Installation Testing: Bowens (Aust)

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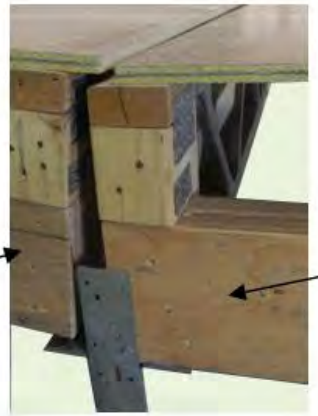
Prefabricated Lightweight Timber Ground Floor Systems



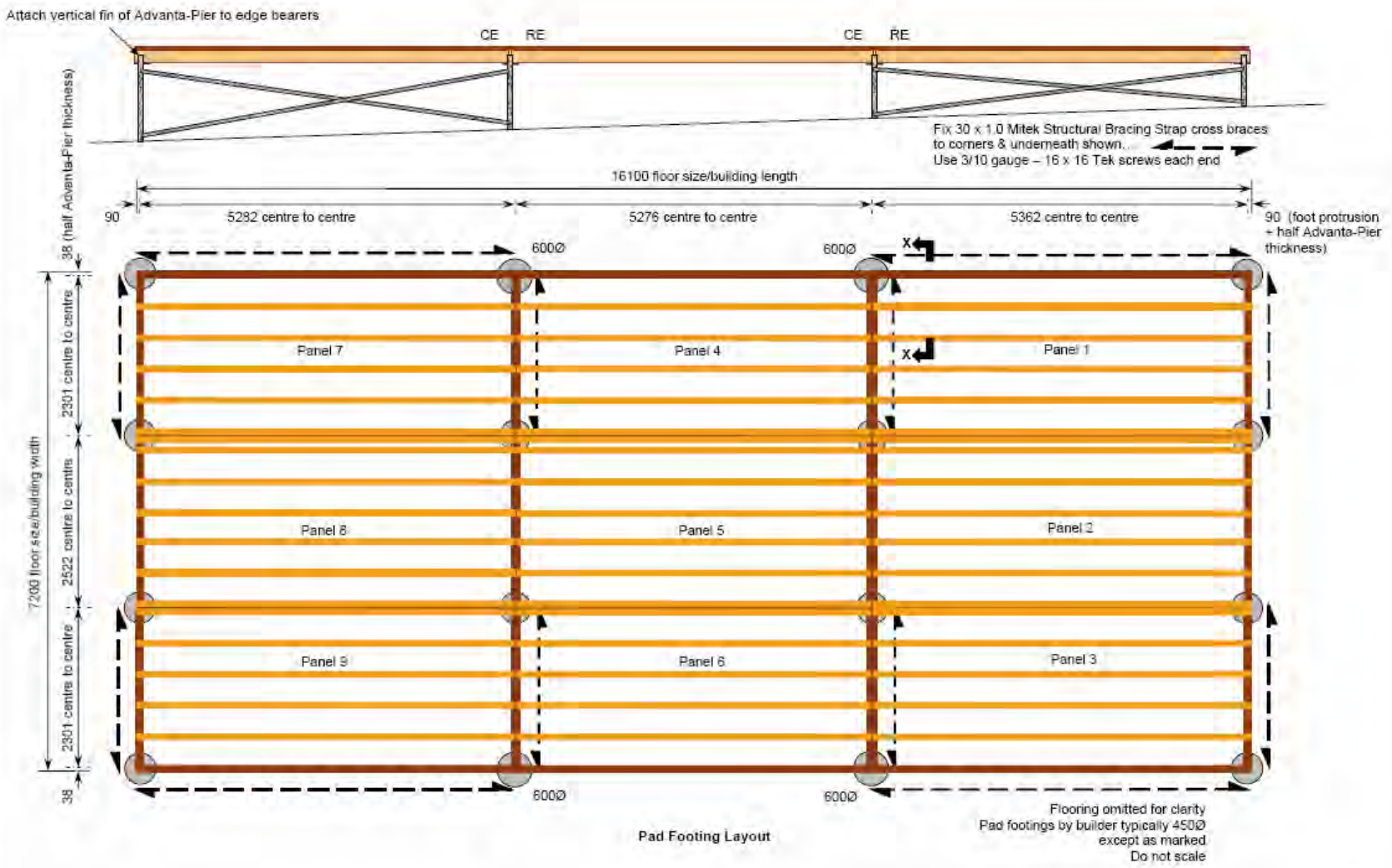
Stage 4: Pilot Phase

I. ‘Full size home floor’ with builder

II. FWPA Technical Advisory Manual

Full Size Home Floor

Prefabricated Lightweight Timber Ground Floor Systems



Title:	Project:	Detail:	Drawn: CS Checked: RT & RS	Date: Nov 2012 Version: 2e Page: 4 of 4
Prefab Floor System Construction Details	Swenrick Constructions "Harris@Heathcote"	Pad Footing Layout & Sub-floor Bracing Detail		

Full Size Home Floor

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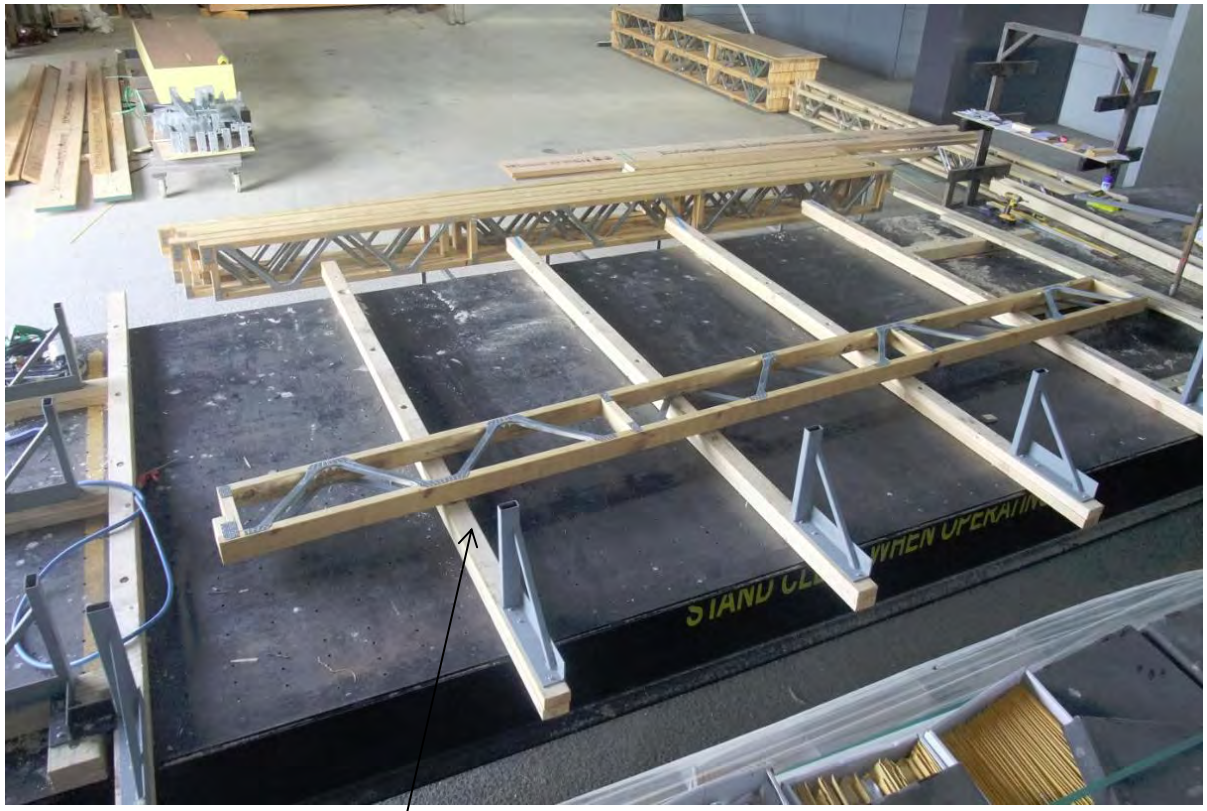
Prefabricated Lightweight Timber Ground Floor Systems



2x90x45 pine fixed on flat to table floor (allows lift for fork access)

400mm high braced verticals set to provide accurate right-angle

Full Size Home Floor

PANEL 6

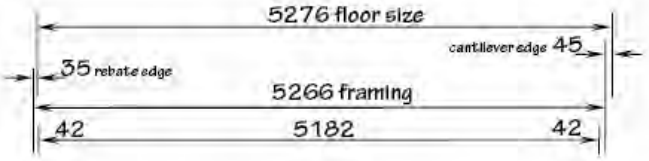
Framing
B1A 2@200x42 LVL15 (1 only per Panel)
B3 2/360x42 LVL15 nail lam.
PosiStruts PS4536
SB 170x35 LVL15 strongback

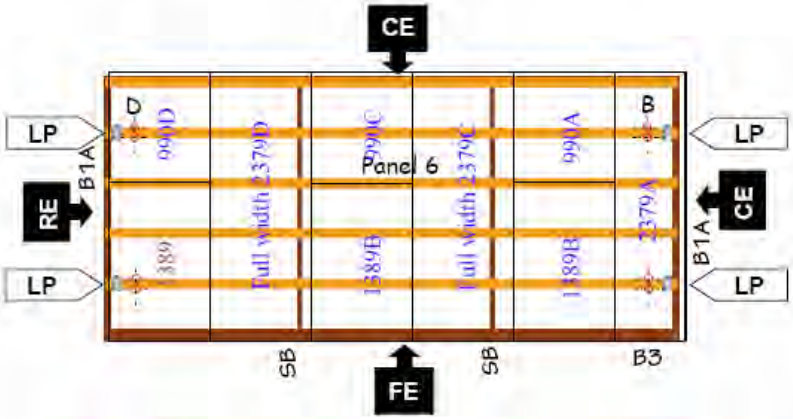
Lifting points LP
Before flooring, fit inverted joist hangers over lifting trusses as shown. Immediately after floor is laid drill pairs of 70mm holes as shown max 250mm from face of bearer. Wipe off any glue & retain plug for refitting after final lifting.

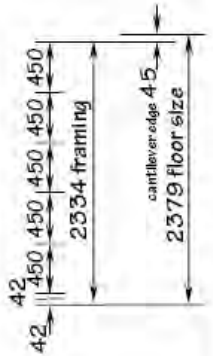
Flooring
4.5 sheets, cut from sheets A, B, C, D & half sheet shared with Panel 5 as shown.
Final floor size must not exceed dimensions given.

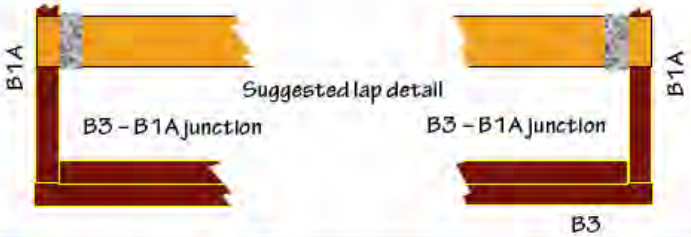
Edge finishes:
FE flush with framing
RE 35mm rebate edge
CE 45mm cantilever edge

Label
Permanent mark each panel with Panel number & lettered corner(s) as shown.









Project:	Detail:	Drawn: CS Checked:	Date: Dec 2012 Version: A Page: 6 of 9
Swenrick Harris @ Heathcote	Panel 6 fabrication details		

Full Size Home Floor

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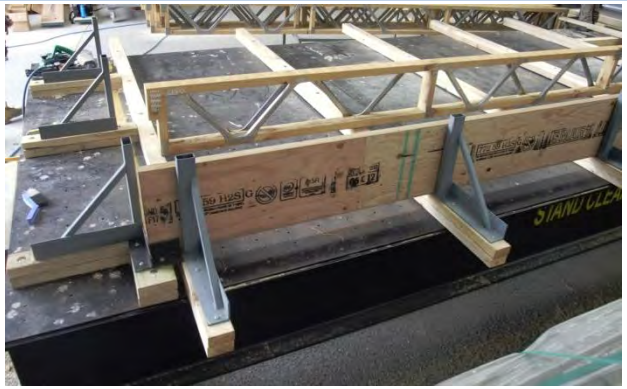

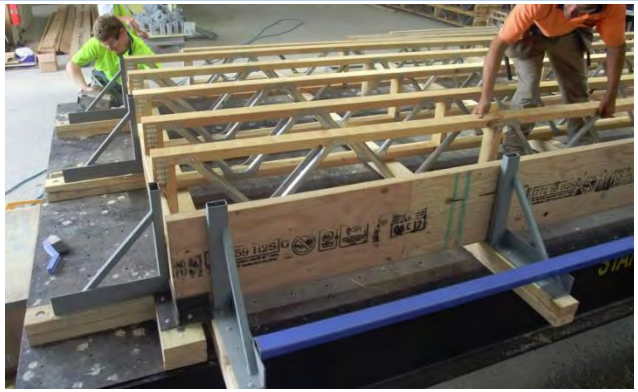

Full Size Home Floor

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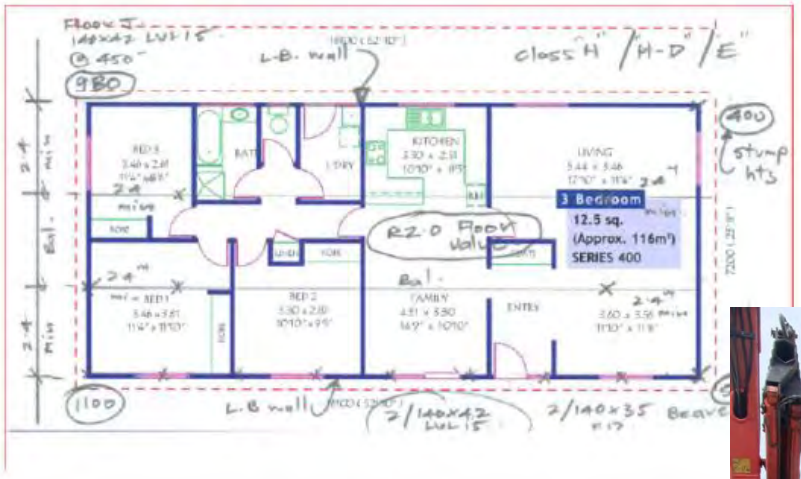

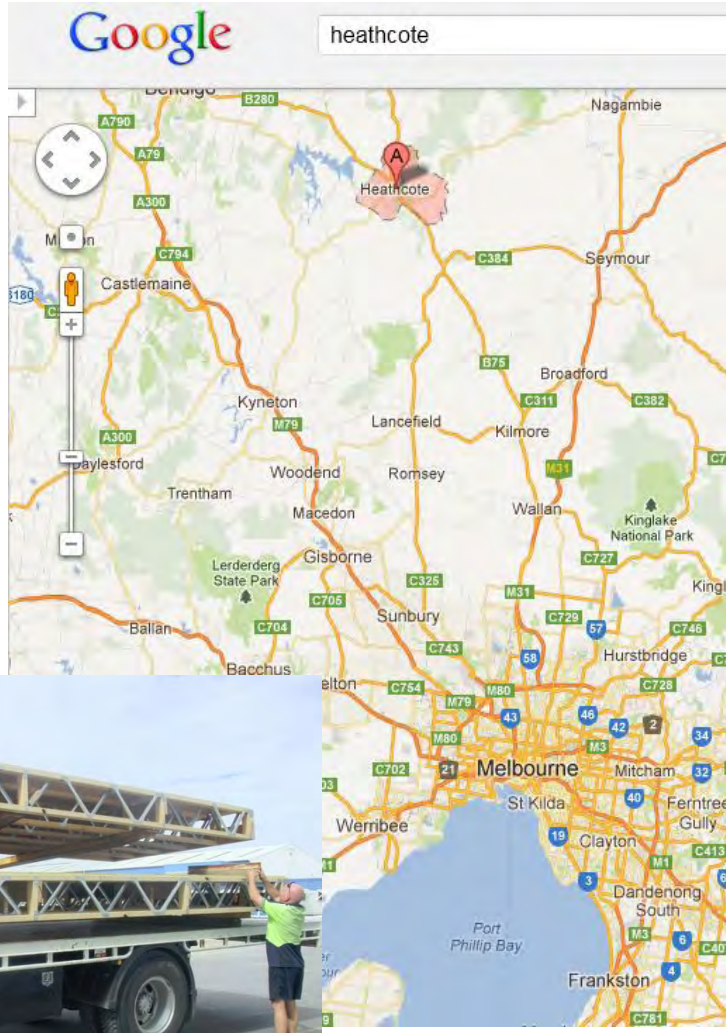

Installation
February 2013

Full Size Home Floor

Adjustable pier installation

Full Size Home Floor

Floor panel site installation

Full Size Home Floor

Floor panel site installation

Full Size Home Floor

Full Size Home Floor

Floor panel site installation

Technical Advisory Manual

Written for frame and truss manufacturers

- Introduction
- Selecting a system
- Design
- Fabrication
- Installation
- Case Study

FTMA
"We support you!"

Market Implementation Strategy

Aim is to manage the introduction so that industry provides a quality solution right from the start. Suggested activities include:

- work closely with Frame & Truss Manufacturers Association;
- Information seminars to be held in each state;
- identify 2-3 innovative and quality F&T manufacturers in each state (Vic, NSW & Qld at least);
- form a small implementation group of these key companies;
- assist companies in understanding the concepts and touting for some jobs in their states;
- assist companies on each job, seeing what we can learn and updating the technical advisory manual;
- work with Pryda, MiTek, Multinail to include in their software;
- further promote the concepts with builders and designers;
- then once we have a number of jobs completed in each state - then starting to share the information more broadly.

FTMA
"We support you!"

Lots of Benefits

- Best construction option for: sloping sites, low lying areas, poor soil conditions
- Guaranteed quality due to manufacture in a controlled factory environment
- Reduced material waste and zero on-site waste
- Ease of floor insulation installation
- Increased on-site construction speed (floor & plumbing)
- Simplified plumbing installation (no jack hammering)
- Post construction adjustment (highly reactive clays)
- Extension of concept to indoor-outdoor living and offering prefabricated timber decks and screens
- Lots of opportunities for additional frame & truss value-add: pre-ink-jetting wall frame positions, pre-cutting holes for plumbers, pre-installing plumbing pipes, fittings or shower bases, pre-fitting waterproof flooring & linings

Information Seminars

FTMA "We support you!"

Detailed information seminars to be held in August

Monday 26th August: **QLD** Seminar - Brisbane

Wednesday 28th August: **NSW** Seminar - Sydney

Friday 30th August: **Vic** Seminar - Melbourne

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Prefabricated Lightweight Timber Ground Floor Systems R&D Project

Forest & Wood Products Australia
Project funded by FWPA

BRANZ

Bowens THE BUILDERS CHOICE

TPC Solutions (Aust) Pty Ltd